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1. DISCOVERY OF GOLD IN VARIOUS STATES

The discovery of gold in payable quantities was an epoch-making event in Australian history, for as one writer aptly phrases it, this event "precipitated Australia into nationhood." A reference to the population figures prior and subsequent to the year 1851 amply demonstrates this fact. Thus on 31st December, 1841, the population of the Commonwealth was only 220,968¹; at the end of 1851 it was still under half a million, viz., 437,665¹, while by the end of 1861 the had reached 1,168,149¹ persons, that is, the population had quintupled itself in twenty years. A short account of the chief discoveries in each State is appended:-

(i) New South Wales. The first authentic discovery of the precious metal in this State was made by "Assistant-Surveyor" James McBrien, on the 16th February, in the neighbourhood of the Fish River, and not far from the scene of Hargraves' memorable discovery twenty-eight years later. In 1839 Count Strzelecki reported the existence of gold in the Vale of Clwydd, near Lithgow, while the Rev. W. B. Clarke discovered the precious metal on the Cox River in 1841, and on the Wollondilly in 1842. In 1839, Hargraves found payable deposits of alluvial gold at Lewis Ponds and Summer Hill Creek, and on the Macquarie River. The news of these discoveries, amplified and distorted by all sorts of rumours, soon caused an enormous influx of people into Australia. The dates of other important finds were as follow :-Rich alluvial leads at Forbes, in 1862; Rocky River near Uralla, 1856; in beach sands at northern rivers, 1870; Gulgong, 1871; Mount Drysdale, 1892; Wyalong, 1893.

1. Figures for these years were given in "A Statistical Account of Australia and New Zealand for 1903-4" as 206,095; 404,889; 1,153,973 respectively, but those refer presumably to the enumerations in the earlier part of the years mentioned.

(ii) Victoria. The first discovery of gold in Victoria was probably that made by the Hon. W. Campbell, at Clunes, in March, 1850. On the 5th July, 1851, notification was made of the discovery of gold in the Yarra Ranges by Mr. L. J. Nichel, and at the Pyrenees Mountains by Mr. James Esmond. Soon after the numerous fields near Mount Alexander were opened up. The chief centres of the gold-mining industry at the present time are in the Bendigo, Ballarat, Beechworth, Castlemaine, Maryborough, Gippsland, Ararat, and Stawell districts. In November, 1906, a remarkable discovery of gold was made near Tarnagulla, where a miner who had prospected the district for years obtained seven ounces of gold from a shaft nineteen feet deep, and some fairly large nuggets being found soon after, the so-called Poseidon rush set in. Several of the nuggets were unearthed within a few inches of the surface. The largest weighed 953 ounces and two others weighed 703 and 675 ounces respectively. The shallow ground was soon worked out, but operations have given satisfactory results in the deeper alluvial.

(iii) Queensland. The first discovery of payable gold in Queensland was that made at Canoona by a party under the leadership of Mr. W. C. Capel. In 1863 gold was found at Canal Creek and Gladstone; Crocodile Creek field was discovered in 1865, Ridgelands in 1867, followed shortly afterwards by Rosewood and Gympie; Townsville was opened up in the following year, and the Gilbert River fields in 1869. Charters Towers dates from 1872; the Palmer goldfield from 1873; the Hodgkinson from 1875; while the celebrated Mount Morgan was first worked in 1882, Croydon in 1886, the Starcke field in 1890, Coen in 1900, and Alice River in 1904.

(iv) South Australia. In South Australia, what is believed to have been the first authentic discovery of gold in the Commonwealth from which actual mining operations resulted was made in January, 1846, at a spot about ten miles east from the City of Adelaide. Although finds were subsequently made in many districts and over large areas, the gold-mining industry has never made very great progress in the State, and South Australia contributes the smallest share of the total gold production of the Commonwealth. There is, however, an immense area of country which has not been systematically prospected. There are numerous deposits of the precious metal at various localities in the Northern Territory, the total yield in 1908 being 8575 ounces, valued at £27,512, of which 1021 ounces were obtained at the Driffield. In June, 1909, a rich find of gold was reported from Tanami, about 200 miles from Hall's Creek and 450 miles to the south-east of Wyndham. Steps are being taken to open up this field by sinking wells to provide permanent water, of which there is a great scarcity in the district. A large number of Chinese are engaged in mining in the Territory. In 1908, out of a total of 824 miners employed, the Chinese numbered 674.

(v) Western Australia. The discovery of gold in Western Australia took place at a much later date than in the eastern States; nevertheless the present production far exceeds in value that of any other portion of the continent. It appears that the precious metal was first detected in 1848, in specimens sent for assay to Adelaide from the Murchison copper and lead deposits. In 1852-53 rich specimens of gold-bearing stone were found by shepherds and others in the eastern districts, but they were unable afterwards to locate the places where the stone was discovered. The late Hon. A. C. Gregory found traces of gold in quartz in the Bowes River in 1854. In 1861 Mr. Panton found near Northam, while shortly afterwards a shepherd brought in rich specimens of auriferous quartz which he had found to the eastward of Northam, but he failed to locate the spot again. Various small finds were made up to 1882, when Mr. A. McRae riding from Cossack to Roeburne, picked up a nugget weighing fourteen ounces. In 1885 Messrs. Hall, Slattery, and others found gold on the Elvire, Margaret, and Ord Rivers. The Kimberley goldfield was opened in May, 1886. Next year the precious metal was discovered at Yilgarn, and the field was proclaimed in 1888, in which year rich finds were also made at Mallina and Pilbara Creek, the Pilbara field being proclaimed in October. The Ashburton and Yalgo fields were proclaimed in 1890, and the Murchison in 1891. In 1892 Bayley and Ford discovered the Coolgardie field, obtaining over 500 ozs. of gold in one afternoon by the aid of a tomahawk. Alluvial was discovered by Frost and party at Goongarrie (the Ninety-mile) in May, 1893. Kalgoorlie (Hannan's) was discovered in June of the same year by Messrs. Flannigan and Hannan, Bardoc in August by Messrs. Cashman and Lee, Siberia by Frost and Bonner in October. There were numerous rich discoveries in 1894, such as at "Mount Jackson," "the Pinnacles," "Billy Billy," and at the celebrated Kanowna diggings. Rich finds were also made Bulong, Londonderry, and the Wealth of Nations, Mr. J. D. Dunn, the discoverer of the latter, obtaining £20,000 of gold in a few days. The "Norsemans" was discovered in July by Mr. L. Sinclair, as also the "Lady Shenton" at Menzies. The "Niagara" was discovered in January, 1895, also the rich field known as the "Hands Across the Sea, at Kunanalling. "Blackboy Hill" field was proclaimed in 1897, "Donnybrook" in 1898, while there were further rich finds in 1899.

(vi) Tasmania. The first discovery of the precious metal in the island State reported to have been made by a Mr. Riva, of Launceston, who is stated to have traced gold in slate rocks in the vicinity of Nine Mile Springs in 1849. A valuable discovery was made in 1852 at the Nook, near Fingal,

and further small finds were reported during the same year from Tower Hill Creek and the vicinity of Nine Mile Springs (Lefroy). During 1859 the first quartz mine started operations at Fingal. In the same year James Smith found gold at the River Forth, and Mr. Peter Leete at the Calder, a tributary of the Inglis. Reef gold was discovered in 1869 at Nine Mile Springs (Lefroy) by Mr. S. Richards. The first recorded returns from the Mangana goldfields date from 1870; Waterhouse, 1871; Hellyer, Denison, and Brandy Creek, 1872; Lisle, 1878 Gladstone and Cam, 1881; Minnow and River Forth, 1882; Brauxholme and Mount Victoria, 1883; and Mount Lyell, 1886.

2. PRODUCTION OF GOLD AT VARIOUS PERIODS

The value of the gold raised each year in the several States and in the Commonwealth from the dates when payable discoveries were first reported. Owing to defective information in the earlier years the figures fall considerably short of the actual totals, for during the first stages of mining development large quantities of gold were taken out of Australia by successful diggers, who preferred to keep the amount of their wealth secret. For South Australia the records in the earlier years are somewhat irregular, and the remark applies to some extent also to the returns for Western Australia and Tasmania.

In New South Wales the production of several important centres, such as Hillgrove and Wyalong, shewed a marked falling-off in 1909. In Victoria the decrease in that year was mainly owing to the closing down of some deep alluvial mines and to the lessened yield from the lode mines at Walhalla, and also from dredging and sluicing. The fall in the gold production in Western Australia is attributable to a decline in one or two mines, the most marked decreases being in the Murchison, North Coolgardie, and Coolgardie Fields. It is stated that generally but little attention was given to prospecting during the year 1909, and that consequently little fresh capital was invested. It is believed however, that the decline in gold production is only temporary, as past experience has shewn that prosperity in the industry occurs in cycles.

The amount of gold raised in the Commonwealth in any one year attained its maximum in 1903, in which year Western Australia also reached its highest point. For the other States of the Commonwealth the years in which the greatest yields were obtained, were as follows:-New South Wales, 1852, Victoria, 1856, Queensland, 1900, South Australia, 1894, and Tasmania, 1899.

The following table shews the quantity in fine ounces of gold raised in each State and in the Commonwealth during each of the last nine years, the value of one ounce fine being £4 4s. 11⁵/₁₁d.

QUANTITY OF GOLD PRODUCED IN THE COMMONWEALTH, 1901 TO 1909

	N.S.W. Fine ozs	Victoria. Fine ozs	Queensland. Fine ozs	S. Aust. Fine ozs	W. Aust. Fine ozs	Tasmania. Fine ozs	C'wealth Fine ozs
1901	173,543	730,450	598,382	21,946	1,703,417	69,490	3,297,228
1902	161,256	720,863	640,463	22,413	1,871,039	70,996	3,487,030
1903	254,260	767,347	668,546	21,247	2,064,803	59,892	3,836,095
1904	269,817	765,596	639,150	18,835	1,983,230	65,921	3,742,549
1905	274,267	747,163	592,622	18,086	1,955,317	73,540	3,660,995
1906	253,987	772,290	544,636	19,122	1,794,548	60,023	3,444,606
1907	247,363	695,576	465,882	9,998	1,697,555	65,354	3,181,728
1908	224,792	670,909	465,085	8,532	1,647,912	57,085	3,074,315
1909	204,708	654,222	455,579	12,796	1,595,270	44,777	2,967,352

3. CHANGES IN RELATIVE POSITIONS OF STATES AS GOLD PRODUCERS

A glance at the figures in the table shewing the value of gold raised will sufficiently explain the enormous increase in the population of Victoria during the period 1851 to 1861, when an average of over 40,000 persons reached the State each year. Victoria maintained its position as chief gold-producer for a period of forty-seven years, or up to 1898, when its production was first outstripped by that of Western Australia, the latter State from this year contributing practically half the entire yield of the Commonwealth. New South Wales occupied the second place on the list until 1876, when Queensland returns exceeded those of the parent State, a condition of things that has been maintained ever since. Up to the year 1884 Tasmania and South Australia in turn occupied the position of lowest contributor to the total gold yield of the Commonwealth, but from 1894 onwards the returns from the former State have been in excess of those of the latter. Taking the average of the last nine years the relative positions of each State in regard to the gold production of the Commonwealth were as follows:-

RELATIVE POSITION OF STATES AS GOLD PRODUCERS, 1901 to 1909.

State.	Annual Average of Gold Production, 1901 to 1909.	Percentage on Commonwealth.
Commonwealth	£	100.00
Western Australia	14,485,648	7,699,285
Victoria		53.15
Queensland		3,079,327
New South Wales		21.26
Tasmania		2,393,049
South Australia		6.72
		267,645
		1.85
		72,200
		0.50

4. METHODS OF GOLD MINING ADOPTED IN EACH STATE

The circumstances of gold mining in the various States are not quite identical, for which reason reference is made to that of each State.

(i) New South Wales.

In New South Wales the earlier "rushes" were to surface alluvial or shallow-sinking grounds. Many of these were apparently soon worked out but there is reason to believe that in some instances payable results would be obtained by treating the rejected wash-dirt on more scientific principles. With the exhaustion of the surface deposits discoveries were made by sinking to what are called deep alluvial leads, representing the beds of old drainage channels in Pliocene times. The first of these deep alluvial leads was discovered at Forbes, in New South Wales, in 1862. The Tertiary deep leads at Gulgong were discovered in 1871. Cretaceous leads occur at Tibooburra, and detrital gold has been found in Permo-carboniferous conglomerates at Tallawang. The method of dredging is at present being extensively used for winning gold from the beds of running streams, and also in loose river flats and other wet ground where sinking would be impracticable. The system was introduced from New Zealand, where it was originally applied with great success on the Clutha River, and there are now dredges working on practically all the auriferous rivers of New South Wales. Hydraulic sluicing is also employed in several places, the necessary machinery being fitted to a pontoon for convenience in moving from place to place. The quantity of alluvial gold obtained, other than by dredging, amounted to 11,514 ozs. in 1909, the chief yields being-Tumbarumba, 1379 ozs.; Stuart Town, 1300 ozs.; Gulgong, 563 ozs., and Major's Creek, 510 ozs. The quantity obtained by dredging was 36,168 ozs.; the largest returns being obtained at Araluen, 10,735 ozs.; Adelong, with 10,321 ozs.; Stuart Town, 4113 ozs.;

Wellington, 6346 ozs.; Nundle, 1378 ozs.; and Sofala, 1788 ozs. The dredges at work at the end of 1909 totalled 66, of which 20 were of the bucket type and 46 were pumping plants. The value of the plants in operation (including recovery plants) was estimated at £309,833, The quantity of gold won from quartz amounted to 157,073 ozs, At the present time the Cobar district is the chief centre of the production from quartz, the yields from the Canbelego and Cobar fields included therein being respectively 43,197 ozs. and 35,009 ozs. Next comes the Murrumburrah field, with 11,390 ozs.; Araluen, 10,735 ozs.; Adelong, 10,321 ozs.; Wyalong, 9981 ozs.; Wellington, 7921 ozs.; and Peak Hill, 6984 ozs.

The table below shews the yield from alluvial and quartz working in each of the principal districts during 1909:-

***GOLD WON IN NEW SOUTH WALES, ALLUVIAL AND QUARTZ, 1909**

District	Alluvial			Total ozs.
	Other than by Dredging ozs.	By Dredging ozs.	Quartz ozs.	
Albert	353	...	1,517	1,870
Bathurst	1,686	76	10,166	11,928
Clarence and Richmond	165	...	696	861
Cobar	...	...	78,402	78,402
Hunter and Macleay	77	...	350	427
Lachlan	386	...	26,450	26,836
Mudgee	1,735	6,346	15,780	23,861
New England	221	...	464	685
Peel and Uralla	1,150	1,378	5,083	7,611
Southern	1,206	11,322	7,284	19,812
Tambaroora and Turon	2,084	6,176	545	8,805
Tumut and Adelong	2,451	10,870	10,336	23,657
Total	11,514	36,168	157,073	204,755

* These particulars are based on information obtained locally from mine and battery owners, and the total of the quantities specified in this table does not agree with the total production as obtained from the Mint and from export and import returns.

(ii.) Victoria. Quartz-reefing predominates in Victoria, although a considerable amount of gold is obtained from alluvial workings, both surface and deep leads. The deepest mines in Australia are found in the Bendigo district, where the two deepest shafts were at the 31st December, 1909, 4355 and 4318 feet deep respectively, while the bottom of the winze at the Victoria Reef Quartz was 4558 feet from the surface. Altogether there were at the close of 1909 no less than fifty-two shafts in this district which had reached a depth of over 2000, feet. A considerable amount of attention is given to dredging and hydraulic sluicing, particularly in the Beechworth, Gippsland, Castlemaine, and Ballarat districts, the number of plants in operation at the end of 1909 being 111, while 9 plants were in course of reconstruction or building. The total quantity of gold won from dredge mining in 1909 was 88,389 ounces, and from sluicing 630 ounces, while the number of gold dredging and hydraulic sluicing leases in force at the end of the year was 234, extending over an area of 21,493 acres. The yields from alluvial workings and quartz reefs as returned (in crude ounces) from the chief mining districts of the State during last year were as follow :-

GOLD WON IN VICTORIA, ALLUVIAL AND QUARTZ, 1909*

District	Alluvial ozs.	Quartz ozs.	Total ozs.
Ararat and Stawell	11,186	7,458	18,644

Ballarat	40,054	95,270	135,324
Beechworth	98,783	22,092	120,875
Bendigo	2,926	216,716	219,642
Castlemaine	22,539	53,651	76,190
Gippsland	6,985	42,872	49,857
Maryborough	50,136	30,747	80,883
Total	232,609	468,806	701,415

* As returned in crude ounces from chief mining districts.

The Virginia, Bendigo, was the largest yielding lode mine, with an output of 36,567 tons for 17,277 ozs., or an average of 9½ dwts. per ton; the greatest yielding deep alluvial mine was the Duke and Main Leads Consols, at Maryborough, with an output of 15,621 ozs.; the Tewksbury Amalgamated, working five dredges, heads the list of dredging and sluicing companies with a yield of 6356 ozs.

(iii) Queensland. Operations in Queensland are at present chiefly confined to quartz reefing, the yield from alluvial in 1909 being only 10,288 ounces, while the quantity produced from quartz was 343,650 ounces; from copper and other ores 95,579 ounces; and from old tailings 6062 ounces; making a total production of 455,579 ounces valued at £1,935,178. The yields from the principal fields are given below :-

GOLD WON IN QUEENSLAND, ALLUVIAL AND QUARTZ, 1909.

District	Alluvial	Quartz	From Copper and other Ores and old Tailings	Total fine ozs.
	fine ozs.	fine ozs.	fine ozs.	
Charters Towers	720	164,282	6,652	171,654
Gympie	401	65,110	40	65,551
Mount Morgan	94	65,283	78,122	143,499
Ravenswood	236	28,491	...	28,727
Croydon	24	5,661	1,828	7,513
Clermont	3,767	159	39	3,965
Etheridge and Woolgar	3,857	5,773	2,396	12,026
Other districts	1,189	8,891	12,564	22,644
Total	10,288	343,650	101,641	455,579

(iv) South Australia. In South Australia alluvial gold has been worked for many years in the gullies round Adelaide, while a fair amount of gold has been obtained by this method at Teetulpa, in the northern areas. There are some valuable reefing fields in the Echunga district, at Mt. Grainger, Barossa, Wadnaminga, Mannahill, etc., but they have not been developed to the extent they deserve. Good stone was discovered a few years ago at Tarcoola, but the present returns are comparatively small. The rich finds at Arltunga in the centre of the continent, within the boundaries of the Northern Territory, have not yielded up to expectations, but the field has not been systematically prospected. It is stated that the gold occurs chiefly in vughs, crevices, and cellular quartz, the latter being at times exceedingly rich. The solid stone is low grade and is not worked. Operations are confined to the vein matter, which is passed through screens, arid the larger lumps hand picked, the fines and all that contains vughs or cellular quartz being saved for treatment and the balance discarded. South Australia is not divided into mining districts as is the case in the other States. The Macdonnell Ranges, although within the boundaries of the Northern Territory and coming under the operation of the Northern Territory Mining Act, yet geographically belong to South Australia proper. All business is done from Adelaide and the administration of the Mining Act south of the 19th parallel of latitude is conducted by the Hon. Minister controlling the Northern Territory, with the help of a resident warden at Arltunga. The total output of gold for

1909 from the Northern Territory amounted to 7953 ounces, valued at £24,148.

(v) Western Australia. In Western Australia the operations are confined principally to quartz reefing, the returns from ordinary alluvial and hydraulic sluicing being comparatively small. The total production of gold from all sources during last year was 1,59,5,270 ounces, of which only 0.5 per cent. was alluvial. The production of gold on the various goldfields during the year 1909 was as follows :-

GOLD WON IN WESTERN AUSTRALIA, ALLUVIAL AND QUARTZ, 1909

Goldfields.	Alluvial Fine ozs.	Dollied and Specimens Fine ozs.	Crushed Fine ozs.	Total Fine ozs.
East Coolgardie	1,391	1,203	896,695	899,289
East Murchison	389	1,644	153,876	155,909
Mount Margaret	954	1,281	153,630	155,865
Murchison	894	2,301	12,911	133,106
North Coolgardie	188	584	78,627	79,399
Coolgardie	364	169	33,602	34,135
Dundas	32	1,582	27,935	29,549
North-east Coolgardie	370	908	24,184	25,462
Yilgarn	...	29	20,880	20,909
Broad Arrow	983	629	15,510	17,122
Peak Hill	60	452	7,407	7,919
Pilbara	1,390	256	5,118	6,764
Phillips River	3	34	6,677	6,714
Yalgoo	1	139	1,665	1,805
West Pilbara	531	...	1,009	1,540
Ashburton	436	...	...	436
Kimberley	135	...	...	135
Other goldfields	...	...	348	348
Total	8,121	11,211	1,557,074	1,576,406

The figures in the above table are compiled from returns from the individual mines and are somewhat incomplete; the total is therefore less than the total shewn on page 496 from mint and export returns.

(vi) Tasmania. The yield from Tasmania is chiefly obtained from quartz reefing, although there is little alluvial mining carried on in the Lisle district . The yields as returned from the chief centres in 1909 are shewn hereunder :-

GOLD WON IN TASMANIA, ALLUVIAL AND QUARTZ, 1909

Description.	Northern and Southern ozs.	North-eastern ozs.	Eastern ozs.	Western ozs.	Total ozs.
Quartz	22,938	219	2,450	18,811*	44,418
Alluvial	240	329	...	65	634

* Gold contained in blister copper and silver-lead bullion.

The total production equalled 44,777 fine ounces, valued at £190,201.

5. REMARKABLE MASSES OF GOLD

The first "nugget" found in Australia was obtained at Hargraves, in New South Wales, on the 13th May, 1851, and weighed a little over 1 lb. In the same year the Burrandong nugget was found near Orange, weighing 2217 ozs. 16 dwts., and the "Brennan" was sold in Sydney for £1156. During the period 1880-82 nuggets weighing from 59 ozs. to 1393 ozs. were found at Temora. The "Jubilee," which weighed 347 ozs., was found in 1887.

In Victoria a nugget found at Canadian Gully in 1853 weighed 16-20 ozs.; the "Welcome." found at Ballarat in 1858, weighed 2217 ozs.; and the "Welcome Strange," unearthed in 1869 at Mount Moliagul, near Dunolly, weighed 2315 ozs., of which 2284 ozs. were fine gold and 31 ozs. silver, and was valued at £9534.

In addition to these alluvial nuggets large masses of gold have been found *in situ* in reefs. A mass known as "Kerr's Hundredweight," discovered in 1851 at Hargraves, in New South Wales, yielded 106 lbs. of gold. Probably the largest mass of gold ever found was obtained in Beyers and Holtermann's claim at Hill End in 1872. The total weight of the specimen, including the small amount of quartz in which it was encased, was 630 lbs. Its dimensions were 4 ft. 9 in. high, 2 ft. 2 in. wide, and about four inches thick. The value was not definitely known, but an offer of £13,000 was refused.

6. MODES OF OCCURRENCE OF GOLD IN AUSTRALIA

(i.) *New South Wales.* The principal gold deposits worked with profit in New South Wales are classified by the Government Geologist of that State as follows :-(a) Alluvial or detrital gold. (b) Auriferous reefs or lodes. (c) Impregnations in stratified deposits, such as slate, quartzite, and volcanic tuff. (d) Impregnations in igneous rocks, such as granite, serpentine, felsite etc. (e) Irregular deposits, such as bunches of auriferous ironstone. The detrital gold is found chiefly in Recent and Pleistocene alluvials, in beach sands along the coast in Tertiary alluvial leads, in Cretaceous alluvial leads, and in Permo-carboniferous conglomerates. In the beach sands the gold is found in association with platinum and tin. In reefs the gangue is principally composed of quartz; calcite is often present, and barytes and fluor-spar are also met with. At Hill End gold was found associated with muscovite. In the oxidised portions of auriferous reefs, limonite, malachite, azurite and cuprite are found, while below the water-line the veins are impregnated with iron pyrites, galena, copper pyrites, zinc blende, pyrrhotine, and stibnite. The auriferous quartz veins fall into three categories-fissure veins, bedded veins, and contact veins. Large masses of gold have occasionally been found in lodes, such as "Kerr's Hundred-weight," alluded to in a preceding paragraph. The so-called saddle reefs in the Hargraves district are identical with those worked so profitably and at such great depths round Bendigo, in Victoria. Altogether gold has been found in association with over forty minerals in New South Wales, one of the most peculiar products being known as "mustard" gold, resultant on the decomposition of tellurides. The substance has the appearance of dull yellow clay, but it readily burnishes when pressed with a knife blade. Native gold has never been found in an absolutely pure state in New South Wales, being always alloyed with silver and also traces of other metals.

(ii.) *Victoria.* In Victoria the occurrence of gold is noted under two main headings -1. Matrix gold. 2. Redistributed gold. The so-called matrix gold occurs in quartz reefs of various kinds, in Ordovician, Silurian, and Lower Devonian sedimentary, metamorphic, and granitoid and porphyritic rocks; in reefs, veins, and lenticular deposits in dykes of granitoid, porphyritic, dioritic, and felspathic rocks, or between dykes and walls of intruded rocks; or in fracture planes or joints in granitoid rocks. Under the above conditions the gold is either free or in combination with iron, arsenic and iron, copper and iron, zinc, lead, antimony, silver, etc.

The redistributed gold is found in sands and gravels of existing streams ,in deep leads, in littoral gravels and sands, and in cleavage and joint planes of rocks underlying the deep leads.

(iii) Queensland. The most remarkable mode of occurrence in Queensland is that at the Mount Morgan mine, which presents so many novel features as to demand special reference. At this mine the siliceous material forming the ore body was found enclosed in igneous rock, which continued to the surface, except for a funnel-shaped mass of sandy beds and secondary ore outcropping near the summit of the mount. In a crevice of these sandy beds was deposited a plug of desert sandstone nearly 100 feet deep at its thickest part, with a surface area of three-fifths of an acre, quite distinct from and unconformable to, the beds of loose sand which underlay and surrounded it, and more ferruginous towards the outside than in the centre of its area. A ferruginous belt extended outside the plug, attaining a depth of 150 feet from the surface. It was hard and extremely rich in gold, which was disseminated through the stone in microscopic particles. Beneath the iron stone there was a band of loose sand or soft bed, in some places many feet in thickness, also extremely rich in gold. Underlying and almost surrounding the secondary ores, a great mass of siliceous and kaolin ore was found, denuded of its gold, which is supposed to have been leached out and conveyed in solution and again deposited in the enriched zone. The impoverishment prevails between the depths of 180 and 300 feet, the friable silicia being cellular from the removal of the pyrites. The evidences of the oxidisation and leaching action are greater towards the centre than along the walls of the mass. Below the skeleton ore an unaltered zone of copper sulphide ore was found, in which gold was irregularly distributed, the copper increasing with the depth. Outside both sulphide and skeleton ore are walls of igneous rocks. Dykes, later than the massive crystalline igneous rocks but older than the enriched zone, traverse the siliceous sulphides in various directions. The theory advanced by Dr. Jack that the formations at Mount Morgan were due to geyser action at one time found wide acceptance, but later investigations tend to discredit it. So far, however, no completely satisfactory explanation has been put forward.

(iv) Western Australia. The Government Geologist of Western Australia classifies the conditions under which gold is found in that State as follows :-(a) Native metal. (b) Compounds with tellurium and other elements. (c) Associated with other minerals.

Native gold occurs in several different forms, to which popular names descriptive of their appearance have been given, such as crystalline, dendritic, rough, flake, mustard, and sponge gold. Tellurides of gold abound at Kalgoorlie and Mulgabbie. Calverite is the most frequently occurring mineral, but petzite, goldschmidtite, and the minerals termed kalgoorite and coolgardite are also found. Of the metallic minerals, iron in the form of iron pyrites and oxides is widely distributed. Galena comes next, whilst amongst other minerals found in association with the precious metal may be mentioned zinc blende, arsenopyrite, vanadinite, bismuth pyrrhotite, chalcopyrite, bourononite, copper, scheelite. Quartz is of course the commonest of the earthy secondary minerals, but calcite, chalcedony, gypsum, actinolite, chlorite, and others are also found in association with gold. Some of the native gold is found to be remarkably pure, specimens of sponge gold from lodes at Boulder, Kalgoorlie, and East Coolgardie being found to contain 99.91 per cent. of the precious metal with but 0.09 per cent. of silver.

7. PLACE OF COMMONWEALTH IN THE WORLD'S GOLD PRODUCTION

In the table given below will be found the estimated value of the world's gold production, and the **share** of the Commonwealth therein during the thirteen years 1897 to 1909. The figures given in the table have been compiled chiefly from returns obtained direct by the Commonwealth Bureau of Census and Statistics from the gold-producing countries of the world.

WORLD'S GOLD PRODUCTION, 1897 to 1909

Year	World's Production of Gold £	Gold produced in Commonwealth £	Percentage of C'wealth on Total %
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1897	48,196,000	9,890,000	20.52
1898	58,136,000	11,679,000	20.09
1899	63,015,000	14,533,000	23.06
1900	52,086,000	13,578,000	26.07
1901	53,339,000	14,006,000	26.26
1902	60,619,000	14,812,000	24.43
1903	66,761,000	16,295,000	24.41
1904	70,554,000	15,897,000	22.53
1905	76,839,000	15,551,000	20.24
1906	83,180,000	14,632,000	17.59
1907	84,770,000	13,515,000	15.94
1908	90,370,000	13,059,000	14.45
1909	91,910,000	12,605,000	13.71

The latest published estimates place the world's gold yield at about 92 million in 1909, towards which the Commonwealth contributed 12½ millions, or about 13¾ per cent. While the production of gold in the Commonwealth rose by about 27½ cent. in the thirteen years from 1897 to 1909, the world's total increased by about 90 per cent. in the same period. The following table will be found interesting, as shewing the various foreign countries where the chief increases have taken place during the interval in question :-

INCREASE IN GOLD YIELD, VARIOUS COUNTRIES, 1897 to 1909

Country	1897 £	1900 £	1907 £	1908 £	1909 £
United States	11,787,000	16,269,000	18,583,000	19,566,000	20,418,000
Canada	1,240,000	5,742,000	1,725,000	2,025,000	1,930,000
Mexico	2,045,000	1,884,000	3,733,000	4,137,000	4,582,000
Transvaal	11,654,000	1,481,000	27,401,000	29,973,000	30,988,000
Rhodesia	800	308,000	2,179,000	2,526,000	2,624,000
Gold Coast	85,000	38,000	1,164,000	1,195,000	979,000
Madagascar	8,500	142,000	267,000	345,000	434,000
India	1,571,000	1,893,000	2,134,000	2,178,000	2,070,000
Korea	208,000	371,000	471,000	480,000	480,000*
Japan	142,000	290,000	396,000	457,000	520,000
Java	24,000	112,000	479,000	610,000	630,000
Costa Rica	2,000	31,000	70,000	122,000	122,000*

*Not available; previous year's figures taken.

The largest increase was recorded in the Transvaal, where the production trebled itself in the thirteen years 1897 to 1909.

The number of persons engaged in gold mining in each State during the last years is shewn in the following table :-

PERSONS EMPLOYED IN GOLD MINING, 1901 to 1909

Year.	N.S.W. No.	Victoria. No.	Q'land. No.	S. Aust. No.	W. Aust. No.	Tas. No.	Cwlth. No.
1901	12,064	27,387	9,438	1,000	19,771	1,112	70,772
1902	10,610	26,151	9,045	1,000	20,476	1,038	68,320
1903	11,247	25,208	9,229	1,000	20,716	973	68,373
1904	10,648	24,331	9,620	1,000	18,804	1,076	65,479
1905	10,309	25,369	10,641	900	18,382	1,207	66,808
1906	8,816	25,304	9,842	900	17,926	988	63,776

1907	7,468	23,291	8,883	914	17,237	953	58,746
1908	6,363	20,853	7,736	1,213	16,075	843	53,083
1909	5,585	18,671	7,150	1,177	17,027	713	50,323

§ 3. Platinum and the Platinoid Metals.

1. Platinum. - The existence of platinum was first noted in New South Wales in 1851 by Mr. S. Stutchbury, who found a small quantity near Orange. Since the year 1878 small quantities of the metal have been obtained from beach sands in the northern coastal district. Platiniferous ore was noted in 1889 at Broken Hill. The chief deposits at present worked in the State are situated at Fifield, near Parkes, but the entire production in 1909 was small, amounting to only 440 ozs., valued at £1720, while the total production recorded to the end of 1909 amounted to 11,578 ozs., valued at £20,713. The matter of treating the extensive surface deposits received further attention during the year, but the difficulty of securing the necessary supply of water has not been surmounted. In September, 1909, the price paid locally for the platinum was increased from £2 17s. 6d. to £3 15s. per ounce. Attempts were made by a French company to treat the sands in the vicinity of Jerusalem Creek in the Woodburn division, but it is represented that it was found that a larger plant is necessary to enable operations to be conducted at a profit; work was therefore suspended for the purpose of raising additional capital.

In Victoria the metal has been found in association with copper at the Walhalla Copper Mine in Gippsland, but the mine is not at present being worked. The metal has also been found in small quantities in black sand beaches in the Otago district of New Zealand, and is present in the alluvial wash at Takaka, Nelson. Up to the present, however, the production has been trifling.

2. Osmium, Iridium, etc. - Small quantities of osmium, iridium, and rhodium are also found in various localities. As far back as 1860, the Rev. W. B. Clarke states that he found native iridium. Platinum, associated with iridium and osmium, has been found in the washings from the Aberfoil River, about 15 miles from Oban, on the beach sands of the northern coast; in the gem sand at Bingara, Mudgee, Bathurst, and other places. In some cases, as for example in the beach sands of Ballina, the osmiridium and other platinoid metals amount to as much as 40 per cent. of the platinum, or about 28 per cent. of the whole metallic content.

In Victoria, iridosmine has been found near Foster, and at Waratah Range, South Gippsland.

Modes of Occurrence of Gold in Australia

New South Wales

The principal gold deposits worked with profit in New South Wales are classified by the Government Geologist of that State as follows : - (a) Alluvial or detrital gold. (b) Auriferous reefs or lodes. (c) Impregnations in stratified deposits, such as slate, quartzite, and volcanic tuff. (d) Impregnations in igneous rocks, such as granite, serpentine, felsite, etc. (e) Irregular deposits, such as bunches of auriferous ironstone. The detrital gold is found chiefly in Recent and Pleistocene alluvials, in beach sands along the coast, in Tertiary alluvial leads, in Cretaceous alluvial leads, and in Permo-carboniferous conglomerates. In the beach sands the gold is found in association with platinum and tin. In reefs the gangue is principally composed of quartz; calcite is often present, and barytes and fluor-spar are also met with. At Hill End gold was found associated with muscovite. In the oxidised portions of auriferous reefs, limonite, malachite, azurite, and cuprite are found, while below the water-line the veins are impregnated with iron

pyrites, galena, copper pyrites, zinc blende, pyrrhotine, and stibnite. The auriferous quartz veins fall into three categories - fissure veins, bedded veins, and contact veins. Large masses of gold have occasionally been found in lodes, such as "Kerr's Hundred weight," alluded to in a preceding paragraph. The so-called saddle reefs in the Hargraves district are identical with those worked so profitably and at such great depths round Bendigo, in Victoria. Altogether gold has been found in association with over forty minerals in New South Wales, one of the most peculiar products being known as "mustard" gold, resultant on the decomposition of tellurides. The substance has the appearance of dull yellow clay, but it readily burnishes when pressed with a knife blade. Native gold has never been found in an absolutely pure state in New South Wales, being always alloyed with silver and also traces of other metals.

Victoria

In Victoria the occurrence of gold is noted under two main headings:

- **Matrix gold** - The so-called matrix gold occurs in quartz reefs of various kinds, in Ordovician, Silurian, and Lower Devonian sedimentary, metamorphic, and granitoid and porphyritic rocks; in reefs, veins, and lenticular deposits in dykes of granitoid, porphyritic, dioritic and felspathic rocks, or between dykes and walls of intruded rocks; or in fracture planes or joints in granitoid rocks. Under the above conditions the gold is either free or in combination with iron, arsenic and iron, copper and iron, zinc, lead, antimony, silver, etc.
- **Redistributed gold** - The redistributed gold is found in sands and gravels of existing streams, in deep leads, in littoral gravels and sands, and in cleavage and joint planes of rocks underlying the deep leads.

Queensland

The most remarkable mode of occurrence in Queensland is that at the Mount Morgan mine, which presents so many novel features as to demand special reference. At this mine the siliceous material forming the ore body was found enclosed in igneous rock, which continued to the surface, except for a funnel-shaped mass of sandy beds and secondary ore outcropping near the summit of the mount. In a crevice of these sandy beds was deposited a plug of desert sandstone nearly 100 feet deep at its thickest part, with a surface area of three-fifths of an acre, quite distinct from and unconformable to, the beds of loose sand which underlay and surrounded it, and more ferruginous towards the outside than in the centre of its area. A ferruginous belt extended outside the plug, attaining a depth of 150 feet from the surface. It was hard and extremely rich in gold, which was disseminated through the stone in microscopic particles. Beneath the iron stone there was a band of loose sand or soft bed, in some places many feet in thickness, also extremely rich in gold. Underlying and almost surrounding the secondary ores, a great mass of siliceous and kaolin ore was found, denuded of its gold, which is supposed to have been leached out and conveyed in solution and again deposited in the enriched zone. The impoverishment prevails between the depths of 180 and 300 feet, the friable silicia being cellular from the removal of the pyrites. The evidences of the oxidation and leaching action are greater towards the centre than along the walls of the mass. Below the skeleton ore an unaltered zone of copper sulphide ore was found, in which gold was irregularly distributed, the copper increasing with the depth. Outside both sulphide and skeleton ore are walls of crystalline igneous rocks. Dykes, later than the massive igneous rocks but older than the enriched zone, traverse the siliceous sulphides in various directions. The theory advanced by Dr. Jack that the formations at Mount Morgan were due to geyser action at one time found wide acceptance, but later investigations tend to discredit it. So far, however, no completely satisfactory explanation has been put forward.

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Remarkable Masses of Gold

The first "nugget" found in Australia was obtained at Hargraves, in New South Wales, on the 13th May, 1851, and weighed a little over 1 lb. In the same year the Burrandong nugget was found near Orange, weighing 2217 ozs. 16 dwts., and the "Brennan" was sold in Sydney for £1156. During the period 1880-82 nuggets weighing from 59 ozs. to 1393 ozs. were found at Temora. The "Jubilee," which weighed 347 ozs., was found in 1887.

In Victoria a nugget found at Canadian Gully in 1853 weighed 1620 ozs.; the "Welcome." found at Ballarat in 1858, weighed 2'217 ozs.; and the "Welcome Stranger," unearthed in 1869 at Mount Moliagul, near Dunolly, weighed 2315 ozs., of which 2284 ozs. were fine gold and 31 ozs. silver, and was valued at £9534.

In addition to these alluvial nuggets large masses of gold have been found *in situ* in reefs. A mass known as "Kerr's Hundredweight," discovered in 1851 at Hargraves, in New South Wales, yielded 106 lbs. of gold. Probably the largest mass of gold ever found was obtained in Beyers and Holtermann's claim at Hill End in 1872. The total weight of the specimen, including the small amount of quartz in which it was encased, was 630 lbs. Its dimensions were 4 ft. 9 in. high, 2 ft. 2 in. wide, and about four inches thick. The value was not definitely known, but an offer of £13,000 was refused.

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